POSITION LOCATION SOLUTIONS

QUALCOMM
CDMA Technologies
Enabling the Future of Communications.™

gpsOne™ enhanced by SnapTrack™
QUALCOMM CDMA TECHNOLOGIES

Printed in USA 7/2000 80-V0557-4 Rev X5

QUALCOMM INCORPORATED CDMA TECHNOLOGIES 5775 MOREHOUSE DR. SAN DIEGO, CA 92121-1714 USA http://www.qualcomm.com/cdmatechnologies <cdma-technologies@qualcomm.com> T (858)658-5005 F (858)658-1556
or: SNAPTRACK, INC. 4040 MOORPARK AVE., STE. 250 SAN JOSE, CA 95117 USA http://www.snaptrack.com <info@snaptrack.com> T (408)556-0400 F (408)556-0404

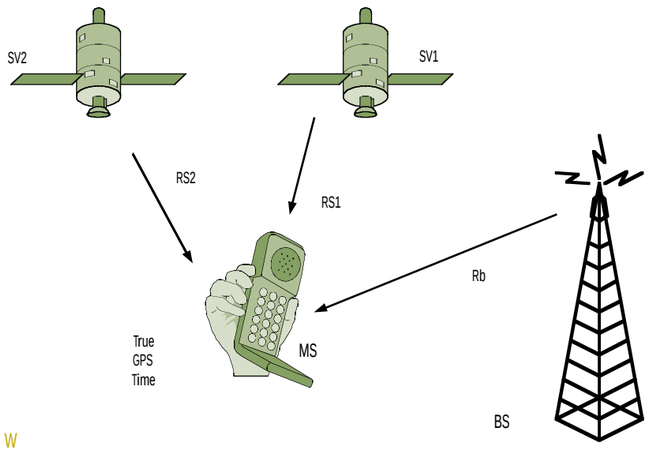
POSITION LOCATION SOLUTIONS

gpsOne™ enhanced by SnapTrack™

QUALCOMM
CDMA Technologies
Enabling the Future of Communications.™

gpsOne™ enhanced by SnapTrack™
QUALCOMM CDMA TECHNOLOGIES

Figure 1. gpsOne Hybrid Solution



OVERVIEW

FCC Mandate

In June 1996 the FCC adopted a report and order for enhanced 911 wireless service (E9-1-1). The mandate requires that cellular, broadband PCS and geographic SMR licensees relay a caller's telephone number to the PSAP, automatically route 911 calls to the appropriate PSAP and provide the location of the originating mobile station (MS). For handset-based solutions, the FCC specifies that wireless carriers be capable of locating 67% of emergency callers to within 50 meters and 95% of emergency callers to within 150 meters.

Value-Added Position Location Applications

Mobile-based position location capabilities enable far-reaching and exciting wireless application opportunities such as productivity enhancement, entertainment, position-based advertising, navigation, asset management and geographic information access. In addition, location information can directly affect how and when decisions are made by people on the move – decisions such as when to take alternate routes; how to avoid traffic, accidents or bad weather; and choosing midpoint destinations or accessing local resources, including gas, food, hotels and taxis. Location information also provides tremendous opportunities for retailers interested in advertising to and attracting qualified customers. Possible position-location applications include the following:

- **Location-sensitive billing:** Wireless carriers can compete with wireline carriers and with cordless handsets by offering comparable rates when the caller is at home or in the office.
- **Location-based information services:** These include driving directions and local information on inclement weather, traffic, restaurants, hotels, department stores and gas stations.
- **Emergency Response:** Emergency requests are automatically routed to the correct PSAP with accurate and timely location information, thereby minimizing the time required to obtain emergency help. This is also useful for automotive roadside assistance.
- **Network planning and management:** Statistics from the wireless network operation can be used to plan network expansion, tuning and deployment, or to dynamically adjust network parameters.
- **Fraud management:** Location information can be used to detect and eliminate fraudulent use.
- **Fleet and resource management:** Resource tracking optimizes resource allocation and reduces response times.
- **Personal-location services:** Employers, parents, friends and relatives can use location services to locate each other.
- **Entertainment:** A wide range of games and social activities can utilize position location. Examples include position-sensitive chat, BBS, cat-and-mouse games, treasure hunts, fortune telling and locating available movie seats.

QUALCOMM INCORPORATED CDMA TECHNOLOGIES 5775 MOREHOUSE DR. SAN DIEGO, CA 92121-1714 USA http://www.qualcomm.com/cdmatechnologies <cdma-technologies@qualcomm.com> T (858)658-5005 F (858)658-1556
or: SNAPTRACK, INC. 4040 MOORPARK AVE., STE. 250 SAN JOSE, CA 95117 USA http://www.snaptrack.com <info@snaptrack.com> T (408)556-0400 F (408)556-0404

gpsOne™ enhanced by SnapTrack™

WIRELESS POSITION LOCATION TECHNOLOGY

Wireless position location can be addressed using either handset-based or network-based methods.

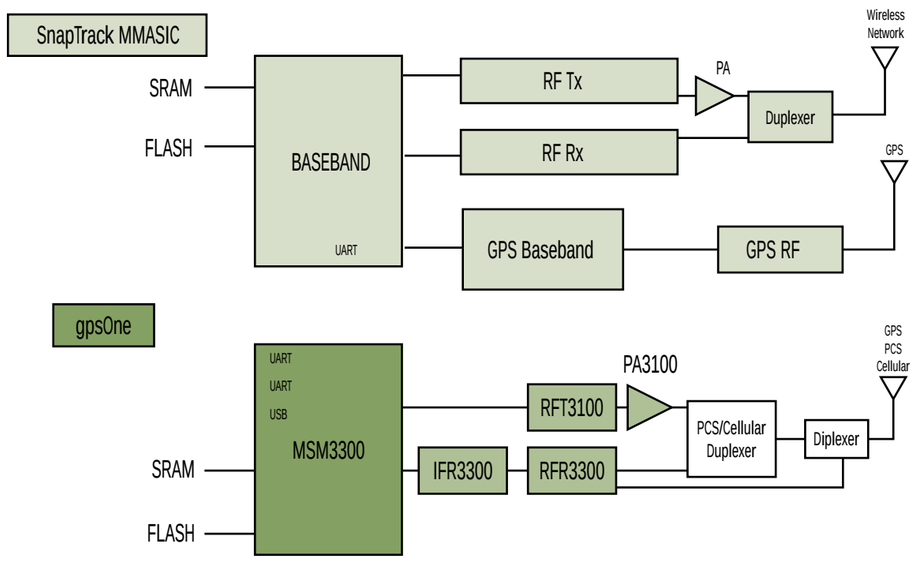
Handset-based Solution

A handset-based method typically relies on Global Positioning System (GPS) capabilities. The GPS solution references a constellation of 24 GPS satellites that circle the earth every 12 hours. As expected, GPS-only solutions exhibit dramatically degraded performance and availability in areas where satellites are obscured, such as indoors or in major urban canyons. GPS-only solutions are also relatively slow to provide a fix and can be costly to implement. Despite recent dramatic improvements in GPS technology, these issues still play a key role in GPS-solution cost, availability and performance.

Network-based Solution

Network-based solutions rely on a signal transmitted from the mobile station (MS) to multiple fixed base stations (BSs). Network-based methods suffer from multipath, diffraction, weak signal conditions and poor cell site geometry that lead to decreased accuracy and availability, particularly in rural and high blockage scenarios.

Figure 2. gpsOne Phone System Solution



QUALCOMM SOLUTIONS - gpsOne AND SNAPTRACK

QUALCOMM has taken a unique approach to wireless position location by taking advantage of the complementary nature of network and GPS solutions. In rural and suburban areas, low cell-site density leads to poor network solution performance and service availability gaps. However, GPS receivers typically excel in rural areas, generally seeing four or more satellites. Conversely, in dense urban areas and inside buildings, GPS receivers often see an insufficient number of satellites to calculate a position fix, but have access to multiple cell sites. The QUALCOMM gpsOne and SnapTrack solutions take advantage of the complementary nature of both network and GPS solutions by using both cellular/wireless network information and satellite-based GPS information to directly improve the positioning availability, sensitivity, accuracy and time to fix.

How Do QUALCOMM's Hybrid Location Solutions Work?

Figure 1 illustrates the gpsOne hybrid solution. The mobile station (MS) collects measurements from the GPS constellation and cellular/PCS network simultaneously. These measurements are combined to produce an accurate 3-D position, even in situations where a GPS solution or network solution alone would have insufficient information to calculate a fix. By combining the two information sources, gpsOne position location solutions can provide a position fix with as few as one satellite and one cell site. Furthermore, infrastructure assistance provides up to 20 dB of added sensitivity beyond that available to a conventional GPS solution. These enhancements enable QUALCOMM's hybrid location solutions to work deep within steel-and-concrete structures or in urban canyons where other solutions fail. Field trials confirm that these solutions meet and exceed FCC E9-1-1 mandated performance in the toughest conditions, while providing unmatched sensitivity and the availability necessary for commercial location-based applications.

gpsOne-Based CDMA Chipset Architecture

Figure 2 illustrates the high level of integration provided by the QUALCOMM gpsOne solution. The gpsOne solution directly leverages inherent CDMA capabilities and architecture to enable tight integration with the CDMA receive chain. In contrast with the discrete conventional solutions commonly found in the industry, no additional ASICs or memory are required. QUALCOMM's MSM3300™ device and future Mobile Station Modem (MSM™) devices include a gpsOne core tightly linked to the on-chip DSP. In addition, QUALCOMM MSM-based solutions leverage SnapTrack™ algorithms for multi-path mitigation and signal enhancement. These leading edge algorithms, combined with the high level of integration, provide unmatched GPS acquisition speed and sensitivity while minimizing cost, space and power.

gpsOne and SnapTrack Position Location Technologies

QUALCOMM and SnapTrack offer a broad range of position location technologies and products for all wireless standards, including cellular/PCS, satellite, or paging; 800/900 MHz; PDC, CDMA, TDMA, GSM or iDEN. These include QUALCOMM's MSM chipset solutions for CDMA, SnapTrack client technology and dynamic multi-mode MMASIC GPS implementation (from stand-alone to wireless-assisted GPS), and SnapTrack PDE and server solutions for all wireless formats.